

Name BETH "KEY" Period _____
Chemical Kinetics Refresher Worksheet

- (a) What is meant by the term reaction rate? **THE CHANGE IN CONCENTRATION/UNIT TIME**
 - (b) Name three factors that can affect the rate of a chemical reaction? **TEMPERATURE/CONCENTRATION/SURFACE AREA**
 - (c) What information is necessary to relate the rate of disappearance of reactants to the rate of appearance of products? **THE MOLE RATIO FROM THE BALANCED EQUATION**
- Consider the hypothetical aqueous reaction $A(aq) \rightarrow B(aq)$. A flask is charged with 0.065 mol of A in a total volume of 100.0 mL. The following data are collected:

Time (min)	0	10	20	30	40
Moles of A	0.065	0.051	0.042	0.036	0.031

- Calculate the number of moles of B at each time in the table. Assume there are no molecules of B at time zero.
- Calculate the average rate of disappearance of A for each 10-minute interval, in units of mol/s.
- Between $t = 10$ min and $t = 30$ min, what is the average rate of disappearance of B in units of M/s? Assume that the volume of the solution is constant.

a)

TIME (MIN)	0	10	20	30	40
MOLES OF B	0	0.014	0.023	0.029	0.034

b)

Time (min)	0-10	10-20	20-30	30-40
RATE = $-\frac{(0.051\text{mol} - 0.065\text{mol})}{600\text{s}}$	$-\frac{(0.042 - 0.051)}{600\text{s}}$	$-\frac{(0.036 - 0.042)}{600\text{s}}$	$-\frac{(0.031 - 0.036)}{600\text{s}}$	
$= 2.3 \times 10^{-5} \text{ mol/s}$	$= 1.5 \times 10^{-5} \text{ mol/s}$	$= 1.0 \times 10^{-5} \text{ mol/s}$	$= 8.3 \times 10^{-6} \text{ mol/s}$	

c)

$$\frac{\left[\left(\frac{0.029\text{mol}}{0.1000\text{L}} \right) - \left(\frac{0.014\text{mol}}{0.1000\text{L}} \right) \right]}{(20\text{min} \times 60\text{s/min})} = 1.25 \times 10^{-4} \text{ M/s} = 1.3 \times 10^{-4} \text{ M/s}$$

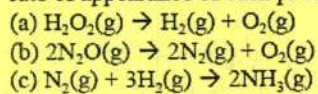
- The isomerization of methyl isonitrile, CH_3NC , to acetonitrile, CH_3CN , was studied in the gas phase at 215°C , and the following data were obtained:

Time (s)	$[\text{CH}_3\text{NC}] \text{ (M)}$
0	0.0165
2000	0.0110
5000	0.00591
8000	0.00314
12000	0.00137
15000	0.00074

Calculate the average rate of reaction between, in M/s, for the time interval between each measurement.

$$\begin{aligned} \text{Rate} &= -\frac{(0.0110\text{M} - 0.0165\text{M})}{(2000\text{s} - 0\text{s})} = 2.75 \times 10^{-6} \text{ M/s} & \text{Rate} &= -\frac{(0.00137\text{M} - 0.00314\text{M})}{(12000\text{s} - 8000\text{s})} = 4.43 \times 10^{-7} \text{ M/s} \\ \text{Rate} &= -\frac{(0.00591\text{M} - 0.0110\text{M})}{(5000\text{s} - 2000\text{s})} = 1.70 \times 10^{-6} \text{ M/s} & \text{Rate} &= -\frac{(0.00074\text{M} - 0.00137\text{M})}{(15000\text{s} - 12000\text{s})} = 2.1 \times 10^{-7} \text{ M/s} \\ \text{Rate} &= -\frac{(0.00314\text{M} - 0.00591\text{M})}{(8000\text{s} - 5000\text{s})} = 9.23 \times 10^{-7} \text{ M/s} \end{aligned}$$

5. For each of the following gas-phase reactions, indicate how the rate of disappearance of each reactant is related to the rate of appearance of each product:



- a) The rate of appearance for H_2 & O_2 = rate of disappearance of H_2O_2 .
 b) The rate of appearance for N_2 = rate of disappearance of N_2O .
 The rate of appearance for O_2 is $\frac{1}{2}$ rate of disappearance of N_2O .
 c) The rate of appearance for NH_3 is twice the rate of disappearance of N_2 .
 H_2 disappears at 1.5 times the rate NH_3 appears.

6. (a) Consider the combustion of $\text{H}_2(\text{g})$: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$. If hydrogen is burning at the rate of 4.6 mol/s, what is the rate of consumption of oxygen? What is the rate of formation of water vapor?
 (b) The reaction $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NOCl}(\text{g})$ is carried out in a closed vessel. If the partial pressure of NO is decreasing at the rate of 30 torr/min, what is the rate of change of the total pressure of the vessel?

$$\text{a) } 4.6 \text{ mol/s} \times \frac{1 \text{ mol } \frac{1}{2} \text{O}_2}{2 \text{ mol/s H}_2} = 2.3 \text{ mol/s O}_2$$

$$4.6 \text{ mol/s H}_2 \times \frac{2 \text{ mol/s H}_2\text{O}}{2 \text{ mol/s H}_2} = 4.6 \text{ mol/s H}_2\text{O}$$

- b) Pressure due to NO decreases at 30 torr/min.
 + Pressure due to Cl_2 decreases at 15 torr/min.

$$\text{Total pressure decrease} = 45 \text{ torr/min}$$

Pressure due to NOCl increases at 30 torr/min

$$(\downarrow 45 \text{ torr/min}) + (\uparrow 30 \text{ torr/min}) = \downarrow 15 \text{ torr/min}$$